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ABSTRACT

Citing several reasons why computers offer the potential to enhance instruction, this paper suggests that the teaching of thinking skills should be integrated into various subject areas by using software programs that involve the use of the skills required in the particular subject area. To illustrate this matching strategy, three software programs--"Hurkel," "Moptown Parade/Hotel" and "Carmen"--are examined. The discussion of each program includes a description of the software, a sample run where possible, and ways in which they can be used in instruction and learning in specific subject areas. Although these examples illustrate that thinking skills software can be integrated into the curriculum, it is noted that teachers must still point out the connections between particular thinking skills and their applications in both academic and out-of-school situations. Three guidelines developed by the Higher Order Thinking Skills Project (HOTS) to promote the development of thinking skills through the use of computer software are then presented: (1) use a variety of programs; (2) design learning to include synthesis of information and skills from multiple subject areas; and (3) organize and prioritize information from the classroom. Five additional software programs appropriate for this purpose are suggested, and teachers and administrators are asked to remember that, although software programs are often presented as games, they are also powerful learning tools. It is concluded that instruction in thinking skills will be enhanced only when the software is carefully selected and appropriately used. Lists of nine references and the distributors of eight software programs mentioned in the text are provided. (DJR)

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INTEGRATING THINKING SKILLS SOFTWARE INTO THE CURRICULUM

by

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National Council of States on Inservice Education
November 21-25, 1986
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During the early 1980's, some educators feared that instruction in critical thinking skills would become a casualty of the back-to-basics movement (Hensen, 1982). They argued that thinking skills were essential to the processing of facts and lent meaning to reading and writing -- that, indeed, thinking skills themselves constituted a "basic" (Hensen, 1982; Olson, 1984). But, however basic they might be, several assessment studies reported that high school students were ill-equipped to handle the critical thinking tasks they would encounter in college or real life (Nickerson, 1984). Partly in response to these findings, several programs aimed at teaching critical thinking and problem-solving skills sprung into existence in the country's public schools and colleges. Though the instructional approaches and theoretical foundations of these programs vary, all would likely agree on a central definition of thinking skills -- those skills necessary for the manipulation, analysis, synthesis, and evaluation of information.

Granting thinking skills their rightful place in the curriculum, one might wonder why computers should be enlisted in the effort to promote thinking skills. As has been noted frequently by teachers and in the professional literature, computer software offers a number of features with the potential to enhance instruction. Using the computer's graphics capabilities of color and animation, software renders abstract concepts more concrete and visual -- and thus, more readily understandable to students. With immediate feedback and the incremental levels of difficulty present in instructionally sound

software, computer-based education allows for individualization of instruction. And certainly not least, students appear to be highly motivated by computers.

In addition, a few research studies suggest software to be an effective tool in the teaching of thinking skills. One study (Bass & Perkins, 1984) reported gains, as measured by standardized tests, in verbal analogies and inductive/deductive reasoning by groups of seventh graders receiving computer-assisted instruction in those areas. Fourth, fifth, and sixth graders -- who were at or above grade level in reading or math -- in the computer-using groups of the Higher Order Thinking Skills Project fared better in thinking ability than students not using computers (Pogrow, 1985). Hearing impaired students using a computer program focusing on logical thinking provided more correct responses than those students receiving equivalent, teacher-led instruction (Smaldino, Schloss, Goldsmith, & Selinger, 1983).

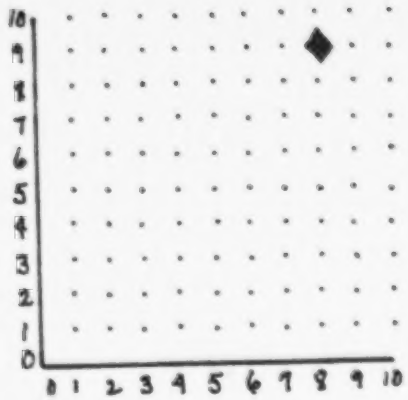
Too, in comparison to other kinds of software, thinking skills software is cost-effective in that it often is not bound to any particular content. That is, the thinking skills stressed in this kind of software are often applicable to a variety of subject areas -- as soon will be shown.

Added to the list of reasons for using software to teach thinking skills -- instructional features, research findings, and cost-effectiveness -- is the large amount of relevant software on the market. But, while the application of drill and practice and tutorial software to the curriculum is fairly straightforward,

that of thinking skills software is less so. The problem, then, becomes one of selecting appropriate software. Ideally, one identifies thinking skills essential to achievement in a particular subject area and then finds software that stresses those same skills. However, in reality, the situation is often reversed. The educational computing enthusiast discovers a potentially promising piece of software and sets out to determine how it can enhance thinking skills instruction in the existing curriculum. Whichever the approach, the strategy for selecting appropriate software is one of matching -- matching the thinking skills stressed in a piece of software with those needed in particular subject areas.

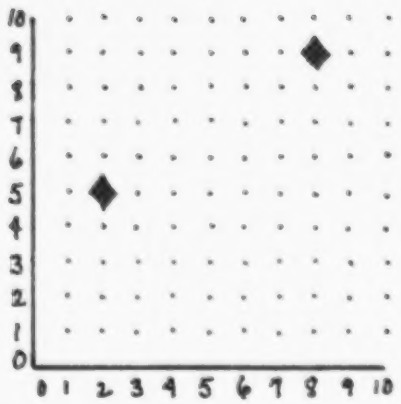
This paper will now examine three pieces of exemplary software to illustrate the matching strategy for selecting pertinent thinking skills software. Each examination will include a description of the software, a sample run when possible, and identification of particular thinking skills and their connection to instruction and learning in specific subject areas.

Using "Hurkle," the student guesses the location of the hurkle -- an animated munchkin -- which is hiding on a horizontal line, a vertical line, a 10 X 10 grid, or a -5 X +5 grid. After each guess -- a single number for the number lines or a pair of coordinates for the grids -- the program provides directional clues. Following is a sample run using the 10 X 10 grid, with the hurkle's location being 3,2:



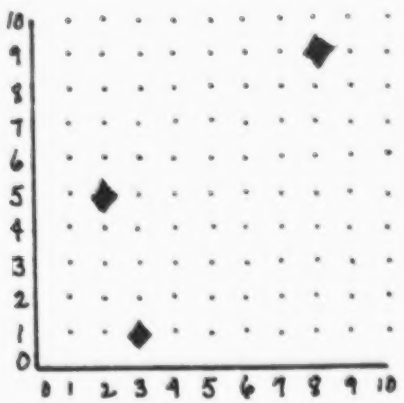
WHERE DO YOU THINK I AM? 8,9
GO SOUTHWEST

The student types "8,9." 8,9 lights up on the grid. The clue, "GO SOUTHWEST," appears.



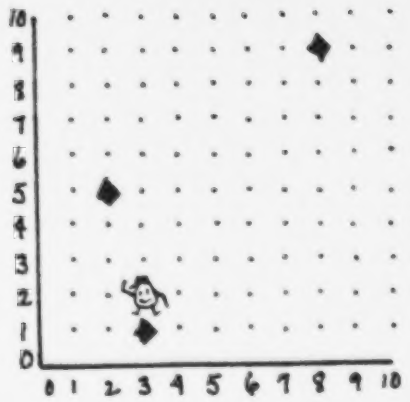
WHERE DO YOU THINK I AM? 2,5
GO SOUTHEAST

The student types "2,5." 2,5 lights up. The clue, "GO SOUTHEAST," appears.



WHERE DO YOU THINK I AM? 3,1
GO NORTH

The student types "3,1." 3,1 lights up. The clue, "GO NORTH," appears.



WHERE DO YOU THINK I AM? 3,2

The student types "3,2."
The hurkle appears at 3,2.

On the next screen, the hurkle dances to the accompaniment of music. The screen that follows informs the student that he/she found the hurkle in four tries.

"Hurkle's" apparent objective is to teach students about number lines and coordinate axis systems -- topics of math classes. "Hurkle" also provides practice in the skill of using directional clues -- and thus, would be appropriate for instruction in map-reading skills in social studies.

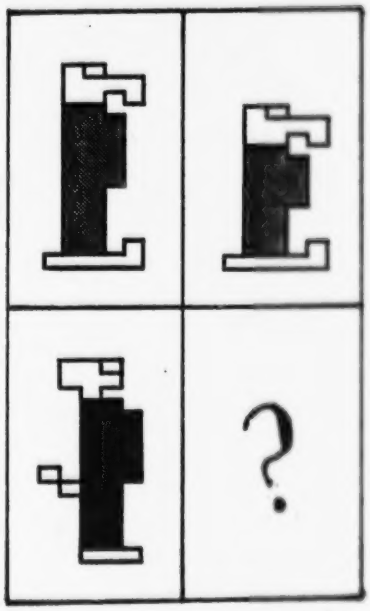
On looking more closely, we see that "Hurkle" encourages logical and strategical thinking. The student uses to clues to progressively narrow down the area in which the hurkle is hiding. More specifically, "Hurkle" discourages random guessing and encourages the student to develop a strategy for determining the hurkle's hiding place in the least number of tries possible. Such a strategy might be guessing midpoints. For example, the student begins by guessing "5,5" and receives the clue, "GO NORTHWEST." Now in the upper right quadrant, the student guesses "8,8," and so on till he/she guesses the correct point.

This particular thinking strategy applies to thinking in

subjects as disparate as chemistry and auto mechanics. The chemistry student, in determining the identity of an unknown chemical, tests first for the most likely chemical and continues narrowing down possibilities as he/she tests. The auto mechanic student follows a similar line of reasoning as he/she checks first the most probable cause of a problem and eliminates possibilites as he/she continues checking till the source of the problem is discovered.

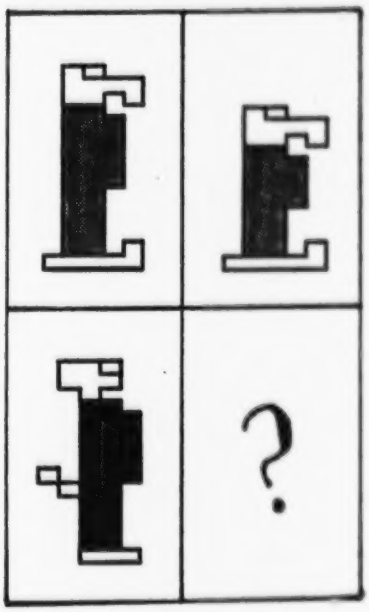
Strategical thinking in general applies to any subject area in which efficiency at solving problem or achieving goals or understanding the mental process by which others have thought strategically is important -- be it math, science, social studies, military history, or physical education.

Moptown Parade and Moptown Hotel provide, on two disks, a series of 14 programs, each requiring progressively more complex thinking. Moptown has 16 inhabitants, each of which has four attributes. Moppets may be tall or short, fat or thin, red or blue, Bibbit or Gribbit. (Bibbits have beaks and big feet, while Gribbits have tails and small feet.) In "Who's Next Door?," the first program on Moptown Hotel, a house with four rooms appears. In order to determine who lives in the downstairs, righthand room, the student must analyze the relationship of the upstairs Moppets and apply it to the first floor pair. Following is a sample run, with the mystery Moppet being a short, fat, blue Gribbit (the darker figures are blue):



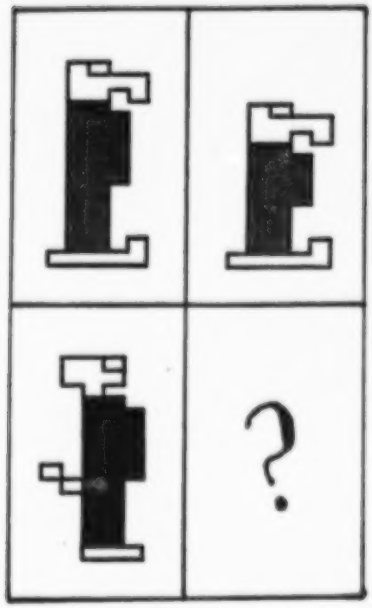
TALL OR SHORT (T OR S) S

The student types "S" for SHORT.



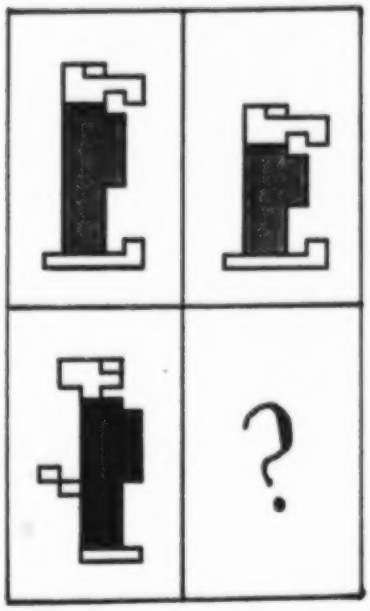
FAT OR THIN (F OR T) F

The student types "F" for FAT.



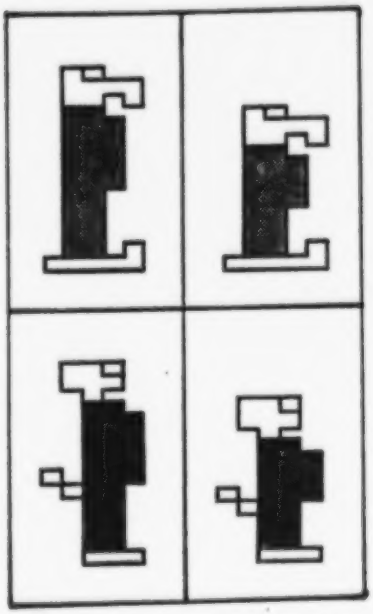
BLUE OR RED (B OR R) B

The student types "B" for BLUE.



BIBBIT OR GRIBBIT (B OR G) G

The student types "G" for GRIBBIT.



YES! IT'S A SHORT, FAT, BLUE GRIBBIT!

The short, fat blue Gribbit appears in place of the question mark, the walls flash, and "YES! IT'S A SHORT, FAT, BLUE GRIBBIT!" appears.

If the student guesses one or more traits incorrectly, the Moppet he/she has described appears in the room -- so the student can visually compare the pairs -- and the program says, for example, "MAKE IT BLUE." The student then tries again.

"Who's Next Door?" is an exercise in discerning relationships -- or, completing analogies -- a thinking skill pertinent to all subject areas. Some examples follow:

Language Arts for vocabulary development:	HOT:COLD :: TRUTHFUL:MENDACIOUS
Science:	NUCLEUS:CELL :: DIRECTOR:MOVIE
	OAK:DECIDUOUS :: PINE:EVERGREEN

Social Studies: MARXISM:COMMUNISM :: CAPITALISM:DEMOCRACY
PARIS:FRANCE :: MEXICO CITY:MEXICO

Computer Science: PROGRAM:OUTPUT :: RECIPE:CAKE

And so on. "Who's Next Door?," being an essentially nonverbal program with a gamelike flavor, might serve as an introduction, or lead-in, to verbal analogies in the subject areas.

Other Moptown programs lend themselves to concept development in the subject areas. For example, in "Clubhouse," the last program on Moptown Parade, the student must determine, through logical reasoning, the rule or rules for club membership. Perhaps only red Moppets or fat Gribbits are allowed to join. "Clubhouse" could thus be used to stimulate a discussion on prejudice in either social studies or literature.

Fortunately for the student, but unfortunately for the reader of this paper, Where in the World is Carmen San Diego? (referred to hereafter as Carmen) is too visually complex to be represented here without the aid of photographs, so a description will have to suffice.

Carmen San Diego is the mastermind of a vast, international crime ring. It is the student's job to track down the suspect of the latest misdeed and arrest him/her -- be it Dazzle Annie or Fast Freddie. After signing in and receiving a description of the crime, the detective has four options: See (travel) Connections, Depart by Plane, Investigate, or Visit Interpol. Let's say the detective first investigates at one of three places

-- the hotel, the bank, or the stock exchange. Going to the bank, the detective learns from the teller ~~informs him/her~~ that a suspicious woman with a limp recently changed her money into lira. The detective then might visit Interpol, enter pertinent data -- "female" and "limp" -- into the agency's computer, and receive a list of suspects with those characteristics. Referring back to the bank teller's clue, the detective might use the almanac, which comes with the program, to find out which country uses lira. The detective then decides to See Connections -- flights are available to London, Rome, and Lima -- and then Departs by Plane to Rome (with precious time ticking away), where he/she continues investigating. Eventually, through entering characteristics of the suspect into Interpol's computer, the detective discovers his/her identity and receives an arrest warrant. After travelling and investigating further, the detective finally succeeds at tracking down and apprehending the criminal.

One could develop a lengthy list of thinking skills exercised in Carmen. In addition to extensive inductive reasoning skills, Carmen requires the student to read and predict what comes next -- a skills pertinent to many subject areas. In the language arts, the teacher might ask students to read an incomplete story and compose an ending. In social study for current events, students might predict the next revolution or the winner of the 1988 presidential election, based on newspaper reports they have read. Too, the study skill of locating information is emphasized as the student uses the almanc throughout the mystery. This particular skill might be

applicable in social studies, science, and agriculture.

Carmen might be used in a more direct and specific fashion in the language arts. In order to experience the mental operations performed by real detectives, students might use Carmen during a unit on detective stories. Such a unit likely would prove quite motivating to students.

From the foregoing illustrations of the strategy by which thinking skills emphasized in software are linked to those in the subject areas, it should be apparent that thinking skills software can be integrated into the regular curriculum. Indeed, the Higher Order Thinking Skills Project (HOTS) sought to create an environment in which "the ideas and strategies that students discover in the computer lab ... are linked to concepts presented in the regular classroom" (Pogrow, 1985, p. 28). Gallini (1985) -- using LOGO, a graphics programming language -- suggests teaching problem-solving within the contexts of subject areas to promote transfer of problem-solving strategies to other situations. And, although the issue of how to teach critical thinking skills -- in conjunction with subject matter instruction or separately -- is quite alive, a number of experts advocate integration (Beyer, 1985; Brandt, 1986; Jones, 1986).

However, in any thinking skills instruction, one should not expect students magically to effect integration. The teacher should point out the connections between particular thinking skills and applications to both academic and out-of-school situations (Beyer, 1985) -- with an eye toward students eventually constructing their own links (Pogrow, 1985).

HOTS proposes other guidelines for the promotion of thinking skills development through the use of computer software. Approach a skill or concept through a variety of programs. For example, other programs in addition to "Hurkle" might be used to help students develop strategical thinking abilities.

Design learning experiences to require a synthesis of information and skills from multiple subject areas. As has been seen with Carmen, the student uses knowledge from social studies, as well as the study skill of using the almanac and the skill of predicting from reading. After solving some of Carmen's cases, the student might be encouraged to write an ending to a given mystery or to write a complete detective story.

Use software to help students organize and prioritize information from the classroom. Using Game Show -- a Password-like program -- and Crossword Magic, students can enter vocabulary words from various subject areas along with definitions or clues -- thereby "teaching" content to the computer. Students also might use software to expand creatively on information gleaned from the subject areas. They might use Print Shop to design birthday cards for famous scientists or mathematicians or musicians or writers, or they might use News Room to recreate newspapers for notable dates in history.

Perhaps the most important, overriding guideline for teachers and administrators in using thinking skills software is to keep in mind that although such programs are often presented as games, they are also powerful learning tools. Resist the temptation to use software as a fringe benefit of education or

only as a reward to students for finishing their work. Seek to integrate thinking skills software into -- not isolate it from -- the curriculum. When carefully selected using the matching strategy and appropriately used, thinking skills software can only enhance instruction.

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Software

Crossword Magic
Gessler Pub.
900 Broadway
New York, NY 10003
212/673-3113

Game Show
Advanced Ideas
2550 Ninth St., Suite 10441
Berkeley, CA 94710
415/526-9100

"Hurkle" on Guessing and Thinking
Minnesota Educational Computing Corporation (MECC)
3490 Lexington Ave.
St. Paul, MN 55112-8097

Moptown Hotel
The Learning Co.
4370 Alpine Rd.
Portola Valley, CA 94025
415/328-5410

Moptown Parade
The Learning Co.

News Room
Springboard Software, Inc.
7807 Creekridge Cir.
Minneapolis, MN 55435
800/328-1223

Print Shop
Broderbund Software
17 Paul Dr.
San Rafael, CA 94903
415/479-1170

Where in the World is Carmen San Diego?
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